The World-Wide Web as a Medium For Presenting LLNL Training Courses

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We have put two prototype courses on the World-Wide Web: an introductory course for new personnel and an on-the-job-training course. This report describes our proof-of-concept work.

Introduction

Many large scientific organizations, such as Lawrence Livermore National Laboratory (LLNL), need to continuously train their employees to keep them knowledgeable and certified, for both safety and environmental/regulatory compliance. Also, new or re-assigned employees need introductory training. Often people need to take a course but must wait until instructors or facilities can be scheduled or until enough students sign up to justify its expense. The classical Lecture-Based Training (LBT) approach is to maintain a waiting list of prospective trainees until there are enough to schedule a class, then make arrangements for the students, the instructor, facilities, and course materials, all to be available at the same time and place.

Computer-Based Training (CBT) seeks to eliminate the scheduling problem by placing the course materials on a dedicated computer so students can cover the materials at their own rate. With this approach, students retain information better (70% for multimedia CBT, vs 10% for LBT). But, in general, CBT requires specialized hardware and software and a facility. Since it is often expensive to produce a course, many highly-specific training courses cannot be justified—for example, training three or four technicians in the safest procedure for working on a piece of high-voltage equipment.

Web-Based Training (WBT) is an evolution of the concept of CBT. WBT uses the technology available for the World-Wide Web for presenting course materials, providing capability for questions and feedback to the author, testing students to verify they have assimilated the information, and automatically notifying the training administrator when a student has taken a test. The existing Web browsers, e.g., Mosaic and Netscape, support presentation of text, images, movies, interactive forms, and interactive images, all of which are used in course presentation. We have added the capability for evaluating the student's progress with true/false multiple-choice tests administered via the Web.

There are several advantages of WBT over conventional LBT:

1) Students can view the course materials at any time and rate, since the Web is always available.
2) Students can view the materials in familiar surroundings, such as their normal workplace or home.
3) There is no need to schedule classes, instructors, or classrooms.
4) The instructor spends less time lecturing. For many on-the-job-training (OJT) courses, the instructor is a fellow worker or a supervisor, so less lecture time reduces time the instructor or supervisor is taken away from normal duties.

There are also several advantages of WBT over CBT:

1) Students don't need to learn to use an unfamiliar computer, since browsers are available for the most common computers at LLNL, i.e., Macintosh, PC, and UNIX workstations.
2) A large (and growing) number of people are already familiar and comfortable with the Web browsers so they are already familiar with the user interface.

3) The architecture of the system is determined by the needs of the organization, not by the software—centralized or decentralized, stand alone or networked.

4) Course materials become reference materials, with updates immediately available to everyone (vs the time and expense of distributing new hardcopy or new course CD-roms).

5) Refresher training for compliance is substantially faster, since students can do a quick review, then take the test.

6) With the Web, it is easy for the course author to include links to other materials, such as Department of Energy Orders, FSP's, OSP's, and prerequisite courses.

7) The software for presenting the course is very inexpensive. Both browsers and servers are available free on the Internet. Commercial versions are nominally priced.

8) The language of the Web, html, is very easy to learn, so course authors need little training before producing course material.

We are exploiting the concept of course "templates," where the boilerplate and structure of a course are already in place, and the author simply inserts the relevant text and images. Courses can be designed as elaborately as necessary. For a simple course the author would gather existing electronic documents, take snapshots, and scan images. An elaborate course might use full Technical Information Department editing, professional camerawork, artwork, and scripting.

Progress

Two particular prototype courses have been put on the Web: an introductory course for new Hazards Control (HC) personnel (HS-0003) and an OJT course for Safing a Laser Amplifier (PSCL-WS-3213). These courses were chosen because they exemplified the characteristics most natural for presentation on the Web. The HC introductory course contains photo images of personnel and facilities, maps, organization charts, and short descriptions of facilities, all of which are readily assimilated without a great deal of interaction between student and teacher. This type of course tends to be a several-hour monologue on the part of
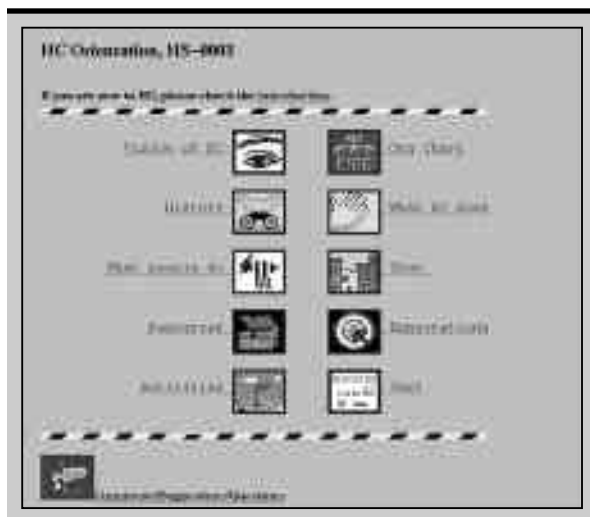

Figure 1. Topics for the HC Introductory Course, identified by icons. Standard icons identify the "Test" and "Opportunity for Questions and Feedback " sections.

Figure 2. History Section for the HC Introductory Course, using text and photos.
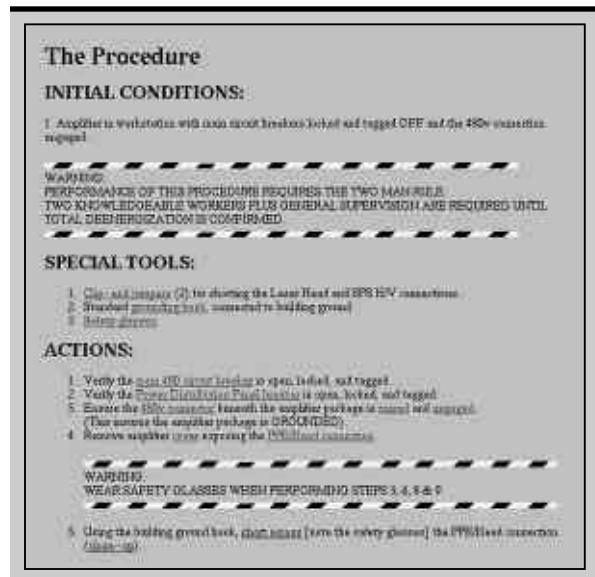

Figure 3. OJT Procedure, with the text linked to annotated photos.

the instructor. When presented on the Web, the course becomes very visual and easy to absorb. For example, the major topics of the course are identified by icons, (**Fig. 1**), and the history section is a mixture of text and photos, (**Fig. 2**).

The OJT course represents a type of course where the desire is to reduce the production costs. The text materials were taken from existing documents in electronic form and easily converted to html, the document language for the Web. For the Procedure section, (**Fig. 3**), we simply took the pre-existing text and made links to photographs of the apparatus, with annotations to indicate the object of interest, (**Fig. 4**). It is also easy to make the material more interesting by adding visual features, like the black and gray striped dividing lines in **Fig. 3**.

The combination of text and photographic images helps the student to become familiar with an apparatus, perhaps without having to disturb an on-going experiment.

Other courses are also at the prototype level, covering Electrical Safety Awareness, the Lock and Tag refresher, and the Hazard Communication portion of the Introduction to New LLNL Employees.
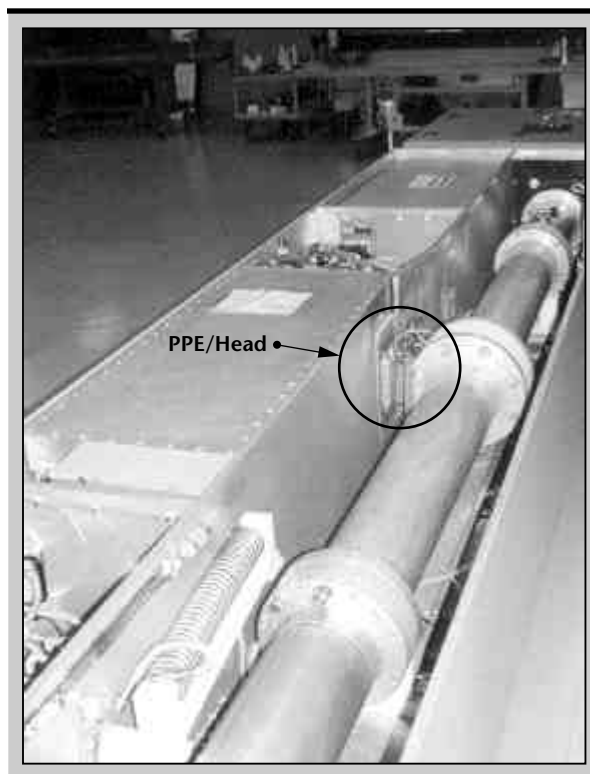

Figure 4. Photograph of the apparatus, annotated to show pulsed-power high voltage head.

Testing

For both types of courses we have provided a true/false, multiple choice test for evaluating how much of the information the student has absorbed. The student uses the Web browser to fill in forms for required information (**Fig. 5**), then moves to the test itself and selects the answers to the questions (**Fig. 6**). When the student is finished, the test is automatically scored (**Fig. 7**), and the results e-mailed to the appropriate training administrator.

Figure 5. Testing: before taking the evaluation test the student enters information on a form.

Figure 6. Test, with true/false multiple choice questions, with answers selected by mouse clicking over a button.

The actual text for the test is automatically formatted from a template file written by the course author and displayed by the Web browser. The author is freed from concerns of numbering the questions and learning the *html* commands for putting up the answer selection buttons, bars separating the questions, and the boilerplate at the beginning and end of the test. An example template is shown in **Fig. 8**, which produces the test questions shown in **Fig. 6**.

Due to limitations in the existing Web browsers and protocols, the administration of the test is on the "honor system" and is as much a self-assessment tool for the student as a mechanism for documenting the student's retention of the material. If it were really important to ensure the student was not cheating, the test portion of the course could be proctored. Future improvements in the Web technology, based on secure Web servers and "digital signatures," could reduce the need for proctoring. Also, one could always resort to the time-honored method of a paper hardcopy test administered in a closed room.
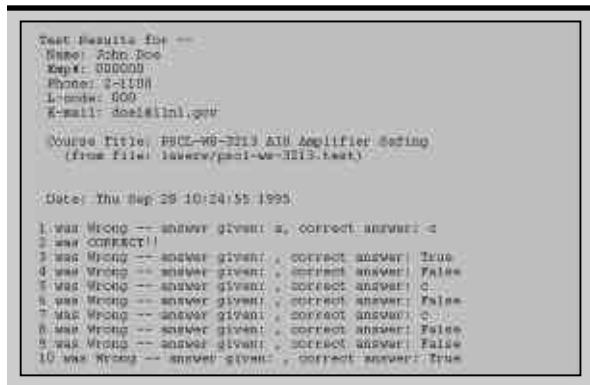

Figure 7. Scoring: the test is automatically scored; the results are shown to the student, and mailed to the training administrator.
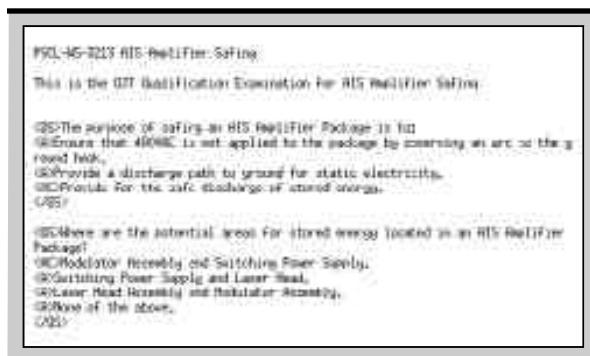

Figure 8. Template: the course author writes a test template, which is automatically processed to produce the test.

Future Work

The WBT courses presently available constitute a proof-of-concept prototype. We are working with training managers in the various LLNL programs to support WBT and develop the teams to put this technology to work. The technical issues to be addressed, include the following:
1) providing an explanation facility for the student to give feedback when an incorrect answer has been chosen;
2) randomly presenting questions from a large pool of questions, so tests are rarely identical;
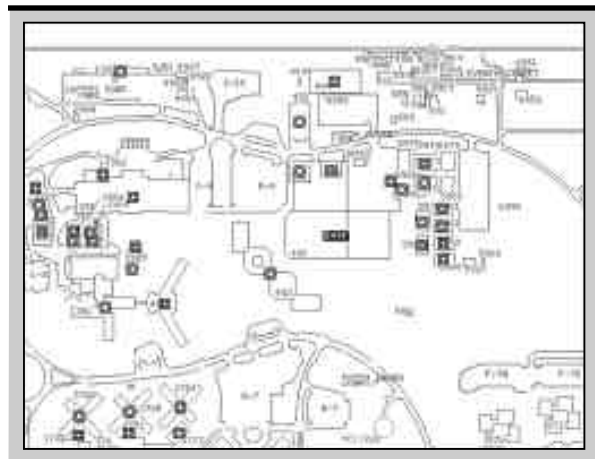3) automatic entry of test results into the LLNL training database software; and

Figure 9. HotMap, indicating the facilities in the LLNL Laser Program as icons.
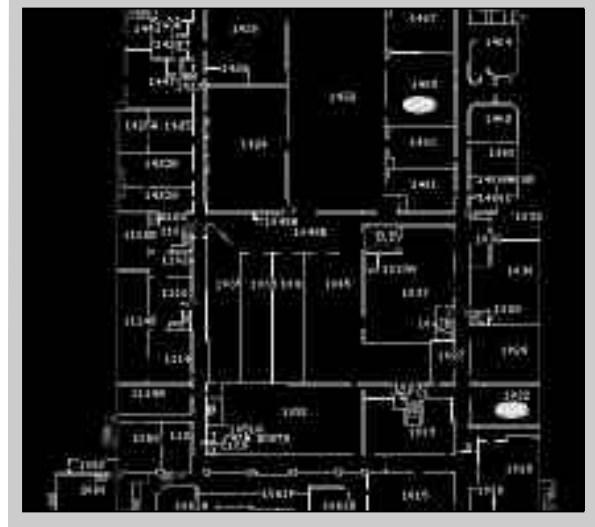

Figure 10. OJT Courses: clicking the Building 490 icon displays a drawing of the building, with icons in rooms where OJT courses are required.

4) management/maintenance issues, when a large number of courses from many organizations are in the system, i.e., keeping a database of information such as course authors and administrators.

None of these technical issues is insurmountable.

Another question we have addressed is how to find courses available for a particular facility. We have used HotMap by D. Ashkenas to display a map of LLNL with icons for facilities in the Laser Program (**Fig. 9**). Clicking on the icon for Building 490 will lead to a drawing of the building (**Fig. 10**), and clicking on the "OJT" icon in room 1022 will lead to the Web page for the OJT courses for that room (**Fig. 11**). HotMap is a tool for browsing course materials based on the geographical location of facilities containing the course subject.

Plant Scale Copper Laser System

B490 R1022 OJT Courses

Procedure Number & Title:

PSCL–LH–3001 Amplifier Copper Reload
PSCL–OPS–3131 Amplifier Leak Check
PSCL–OPS–3132 Amplifier Start–up and Ramp–up
PSCL–OPS–3136 Amplifier Disconnect
PSCL–WS–3209 AIS Laser Head Removal
PSCL–WS–3210 AIS Laser Head Installation
PSCL–WS–3211 Amplifier Tube Alignment
PSCL–WS–3212 Internal Leak Check

PSCL–WS–3213 AIS Amplifier Safing
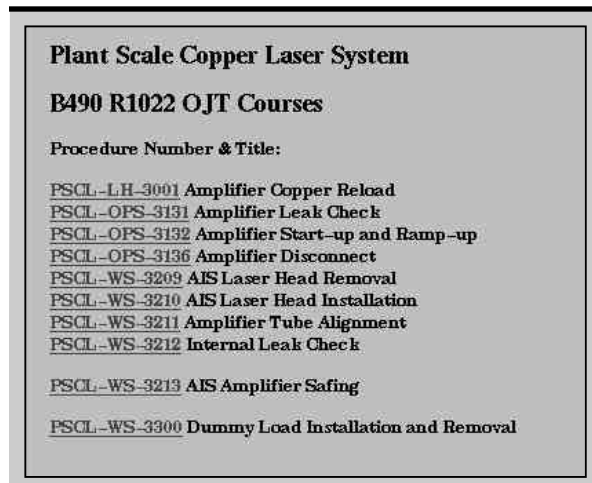
PSCL–WS–3300 Dummy Load Installation and Removal

Figure 11. OJT Courses: clicking the OJT icon displays a Web Page, listing the courses for the laboratory. Clicking the Course Title begins the course.

Acknowledgments